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REPORTS ON SOVIET ANESTHESIOLOGY

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FOREWORD

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EXPERIENCE IN THE USE OF MYORELAXANTS FOR OPERATIONS FOR PULMONARY TUBERCULOSIS

Following is the translation of an article by G. D. Monchenko of the Novochoerkassk Anti-Tuberculosis Sanatorium in Novyy Khirurgicheskiy arkhiv, No 6, Kiev, June 1961, pp. 35-38.

Combined intratracheal anesthesia has become an integral part in the practice of phthisiosurgery. In addition to other advantages which are connected with general anesthetization, this intratracheal anesthesia allows one to use muscle relaxants. The controlled respiration which is used under this decreases the anesthesia dose and improves the oxygenization in the organism. The relaxation of the skeletal musculature lowers basal metabolism and the muscle oxygen requirement, and enables one to conduct a more superficial anesthesia.

In operations on the chest organs, great significance is assumed in the anti-shock action of the relaxants. Lung complications after a resection of a lung is found more rarely when they are used (Bamforth).

"Muscle relaxants of the depolarizing type (Dithilin, Lysthenon, Myorelaxin and others) have advantages over the non-depolarizing ones (Diplacin, Paramion and others). The rapid onset of the relaxation and the short-term duration of the former enable one to use them for intubation and in the course of the anesthesia for a rapid reduction of respiration. Dithilin does not have a contraindication for usage."

In the Novochoerkassk Anti-Tuberculosis Sanatorium we have used a combined (ether-oxygen and in a few cases with nitrous oxide) intratracheal anesthesia in combination with muscle relaxants in 58 operations (Ya. G. Rozinov, surgeon). There were 13 pneumonectomies, 14 lobectomies and bilobectomies, 4 pleura-pneumectomies, 6 decortications of the lung, 15 thoracoplasties of various types, 2 thoractomies, 2 extrapleural pneumolyses, and one extrapleural resection of the primary bronchus cult.

Potentialization of the anesthesia with Aminazin and Dimerdrol was used in 25 patients. Neuroplegics were introduced once intramuscularly $1\frac{1}{2}$ -2 hours prior to the operation in the following doses: 2.5% Aminazin solution, 1 ml; 1% Dimerdrol solution, 2 ml. In the rest of the cases we used a simple direct preparation with Promedol and Atropine.

The first dose of the relaxant for investing the intubation was given after the slow administering to the patient of the anesthesia which was a 1-1.5-2% solution of thiopental (0.3-0.7 g of the dry substance). We used Diplacin (2% solution, 4-5 ml) Dithilin (1 mg for 1 kg of the patient's weight in the form of a one percent solution) or Lysthenon

forte (5 ml). The advantage of the depolarizing relaxants in the given instance is well known. Diplacin due to the gradual development of the relaxation inclines to hypoxemia particularly in the early attempts at intubation.

"As a consequence of a too rapid introduction of thiopenthal in the background of oxygen inhalation for patient B, cyanosis began. The introduction of Diplacin and the hurried attempt at intubation exacerbated this and even strengthened laryngospasm. Only after giving large doses of oxygen and the repeated injection of Diplacin for several minutes was it possible to intubate the patient successfully."

After intubation we continued the relaxation with the stopping of respiration for the extent of the entire period of the operation. Controlled respiration was carried out with the bag on the anesthesia machine or with the DP-2 spiropulsator which was connected to a separate oxygen tank. The spiropulsator was used over a period of 15-30 minutes and during this period they increased the ether dose in connection with the hyperaeration of the lungs and the decrease in the anesthesia saturation of the organism.

The positive aspects of using a spiropulsator are the active expiration which provides for the evacuation of CO₂ from the respiratory tracts and the freeing of the anesthesiologist's hands.

For stopping respiration we used Diplacin, Dithilin and Lysthenon. In 12 operations for protracted and constant relaxation we gave a drop injection of a 0.2% Dithilin solution in a 0.8% sodium chloride solution. For one hour of controlled respiration, 500-800 mg of the compound were needed. A correlation was established between the constitution of the patient under anesthetization and the dose of Dithilin; the persons with a well-developed skeletal musculature needed a larger amount of the relaxant.

According to another method, the Dithilin (or Lysthenon) was injected in a 5-10 ml dose of a 1% solution at the moment that spontaneous respiration was to be stopped, and this determined the appearance of the constriction of the diaphragm and the movements of the respiratory bag or the fluctuations of the water manometer which was connected to the adapter of the apparatus. Our observations on 25 patients coincide with the data of V. A. Kavanov. A lengthening of the Dithilin's action was noted which caused us to decrease the single dose toward the end of the operation.

For an hour of controlled respiration, from 220-1000 mg of Dithilin was needed (depending upon the degree of development in the patient's skeletal musculature).

Drop injection provides for a constant and equal relaxation and is more expedient for operations which are not connected with the separation of a thick concretion. The fractional method is preferred for operations which are accompanied by a major trauma, for the periodic observation of the respiration permits one in addition to judge the patient's condition. With the drop method one must consider the introduction of the physiologic solution of sodium which brings about hypokalemia (I.S. Zhorov).

Diplacin over the course of the operation was given to 8 patients according to the standard method: first 4-5 and the 2-3 ml of a 2% solution were given; up to 16.5 ml was allowed for the entire operation. The slow dying away and ever so slow reduction of respiratory movements compel one to turn to auxiliary respiration for a significant period.

To a good degree the myorelaxants are safe from shock. Nevertheless of the 38 operations dealing with manipulations on the root of the lung, 23 were performed under a general anesthesia with an additional local anesthesia (from 30 to 200 ml of a 0.25% novocaine solution in the area of the reflexogenic zones. The indication for administering the local was the presence of a thick concretion of the lung with the diaphragm and mediastinum.

The measurement of the pressure in the machine has shown that with controlled respiration it reaches 16 cm of water (in the cases of one-lung anesthesia, 10-12 cm). Spontaneous respiration on the other hand creates a pressure of 6-8 cm of water. Such an increase in the partial pressure of the gaseous anesthetics under controlled respiration significantly potentiated the anesthesia; this appears when using Diplacin (T. F. Zyablina) as well as with Dithilin (M. S. Grigor'yev and M. N. Anichkov, I. A. Shrayev and V. G. Zorya).

This is particularly marked when using nitrous oxide. Controlled respiration with nitrous oxide with oxygen in a 1:1 proportion with the addition of small doses of ether (15-30 ml per 1 hour of operation) for anesthesia under the semi-open method permits one to keep the anesthesia at the first level of the surgical stage.

In certain less serious operations (thoracotomies, partial thoracoplasties), if the pre-operation condition of the patient is good there is no necessity of having controlled respiration over the entire operation.

In such instances we gave a relaxant in the aim of creating better conditions for the operating.

Extubation as a rule was carried out immediately upon the termination of the operation with the restoration of the coughing reflex (N. M. Amosov, Marchali). Respiration returns during the last 10-15 minutes of the operation. We extubated only three patients in the post-operative room.

Twice after extubation and still while there was not the complete restoration of spontaneous respiration we observed cyanosis and difficulty in expectorating mucus; this required aspiration of the latter and the administering of auxiliary respiration by the massaging method. One patient which had received during anesthetization 620 mg of Dithilin, after the operation and over the course of one-half an hour had apnea; this we attributed to hyperaeration (during the traumatic pleuropulmonectomy, 9-10 and more litres of oxygen had been administered per minute). Respiration returned after the accumulation of CO₂ and the introduction of Iobelin.

The complications which we have described are connected not with the application of relaxants but rather with the incorrect handling in the post-operative period.

Patient L experienced atelectasis in the remaining part of the lung after a bilobectomy; this continued for several days and was eliminated by standard drugs. Since respiration and the coughing reflex had completely returned before extubation, we cannot attribute this complication to the relaxants.

Moderate tachycardia in one case (Female patient F. Lower lobectomy) can be related to the pre-operation injection of Aminazin.

An exacerbation of the tuberculosis process was not noted after the operation.

Conclusions

1. The application of the muscle relaxants and controlled respiration over the entire operation on the lungs creates the optimal conditions for the oxygenation and anesthetization of the patients.
2. Dithilin and Lysthenon, when used for facilitating intubation and as well in the course of the operation possess advantages over Diplacin.
3. For operations which are not connected with the destruction of a heavy concretion, it is rational to use the drop injection of Dithilin; in traumatic operations, the fractional method is called for.
4. Local anesthesia of the "shockogenic" zones in the absence of major concretions is not obligatory.

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- (Author's address: Rostov-on-Don, Oborony st., No 40, apt. 4)

CARDIAC ARREST DURING ANESTHESIA FOR PATIENTS WITH BURNS

Following is the translation of an article by M. Ya. Hausevich, Z. I. Yemel'yanova and B. S. Vildhriyev (Cand. of Med. Sciences), from the Chair of Hospital Surgery No I (Professor I. S. Kolesnikov, Chief) in the Military Medical Academy (Order of Lenin) imeni S. M. Kirov [abbrev. VOILA], in Novyy Khirurgicheskiy arkhiv, No 6, Kiev, June 1961, pp. 38-41.

At present clinical death is no longer viewed as an irreversible pathological condition. The complex of simultaneously administered treatments enable one to revive a significant number of patients if the reasons for cardiac arrest are not changes that are absolutely incompatible with life.

The evolution of methods for reviving the patients in the last two decades has attracted the increasing attention of surgeons, anesthesiologists and pathophysiologists. In our country V. A. Negovskiy and his associates on the basis of clinical and experimental research have created a complex method for treating patients in the condition of agony and clinical death. The effectiveness of the administered measures is determined chiefly by the time which elapses from the moment of cardiac arrest to the beginning of revivification.

The organization of specialized departments for people with burns and the wide dissemination of the operative method for treating deep burns makes the study of revivification for this group of patients very real.

In the accessible material we have found communication on 10 observations of cardiac arrest during anesthesia for plastic surgery involving burns.

I. Rook (1953) observed cardiac arrest during operations on three children with severe burns. They had all been operated on soon after the trauma. The indications of cardiac arrest were cyanosis, the dilation of the pupil of the eye, and the disruption of respiratory rhythm. Two died and one child was saved by the massage of the heart.

I. Craft, R. McCormack, and W. Dall (1957) described a case of cardiac arrest in one patient with extensive (38% of the body surface) third-degree burns. The operation was conducted on the 10th day after trauma under an intratracheal anesthesia. At the moment of extubation, laryngospasm and cardiac arrest arose. A thoracotomy was performed. The heart was in the condition of fibrillation. With the intracardiac injection of potassium chloride and massaging, they were able to revive the heart's activity after 21 minutes. Two months later the patient

underwent a repeat operation under a spinal and regional anesthesia. He recovered.

In 1958, I. Mincriff in an article based on an analysis of more than 1000 observations of complications with burns, described cardiac arrest during the administering of the anesthesia in three patients. With one patient arrest occurred twice--after intubation in attempts to operate 29 and 36 days after the trauma. In all cases thoracotomy and heart massage were given. One patient recovered, another died two months later from sepsis, and the third's heart activity returned, but he died 8 hours later.

F. Master, I. Hanse, D. Robins (1959) in 3008 plastic operations observed cardiac arrest during anesthesia in 7 patients. In three of the patients operated on for extensive (from 35-45% of the body surface) burns under the condition of marked emaciation, it occurred after the administration of anesthesia and intubation.

In the Clinic of Hospital Surgery of the VIOLA in the 400 cases of administering intratracheal anesthesia for skin grafting on patients with burns, there were two cases of cardiac arrest during the anesthetization. The coincidence of the given literature with ours permits one to make the conclusion that the danger of this complication in patients that have been burned is very great. It is worth noting the fact that both instances occurred in 1959 when the co-workers at the Clinic had gathered significant experience both in operations for treating burns and in administering anesthesia.

Case 1. Male patient, 22 years of age, entered 1/13/59 in the condition of serious shock in connection with 2nd, 3rd and 4th degree burns on the face, wrists, hips, shins and perineum (35% of the body surface) which were received in an acetone fire. He came out of shock two days later.

1/21/59: under intratracheal ether-oxygen potentiated anesthesia, they excised the necrotized tissue on the hips and shin. 1/27: under intratracheal potentiated anesthesia an autoplasty of the derma was performed. We closed 1800 cm² of the wounded surface. Both of these operations were carried out without complications. After the second operation there was the transmission of pneumonia. The grafts adhered completely, and there remained a total of 1200 cm² of unclosed wounds.

Frequent massive blood transfusions. The content of albumen in the blood plasma 5.6%, hemoglobin 71%, 11.8 g%. 2/25 an operation. Ninety minutes prior to anesthesia, he was given 25 mg of Aminazin, 40 mg of Panthopon, 40 mg of Dimedrol and atropine. The anesthesia was begun on a reversible bed which the patient was kept on at all times. For three minutes, during the constant administration of oxygen, he was given intravenously 12 ml of a 2% solution of thiopental sodium. The patient fell asleep, after which he was given 6 ml of a 1% solution of Dithilin and intubation was carried out. Controlled respiration was begun. At this moment there appeared sharply marked cyanosis of the skin and mucous membranes, the pulse became feeble and a minute later was no longer found. The pupils dilated. We administered intravenously 2 ml

of a 0.1% solution of adrenalin and 1 ml of a 0.1% solution of atropine. Through the fifth intercostal space we opened the left pleura cavity, intersected the cartilage of the fifth-sixth rib and opened up the pericardium. The heart was not beating. Into the left ventricle we injected 2 ml of a 0.1% solution of adrenalin, and began to massage the heart (3 minutes after the arrest of its activity). Simultaneously we began to feed blood into the left humeral artery. The celiac aorta was compressed. Artificial respiration was administered throughout.

After ten minutes, regardless of the massage and the double injection of 2 ml of a 0.1% solution of adrenalin intracardially, the heart activity did not return. They administered intra-arterially 2 ml of a 0.01% solution of strophanthin, and massaging was continued.

Twenty-five minutes after cardiac arrest the first weak heart beats appeared. Massage was continued. In another 4-5 minutes independent respiratory movements began. In another 35 minutes the heart beat grew stronger, and pulse appeared in the peripheral vessels. Arterial pressure was 100/60 mm of mercury. The pupils contracted. Over this time there had been a 500 ml blood transfusion intra-arterially. Intravenous drop transfusion was continued. The wound in the chest wall was sewn up.

Three hours and 20 minutes later the patient regained consciousness. There was no sort of cortical disturbance. Later his condition for a long time remained critical, and double pneumonia developed. By 3/17 his condition improved. 3/18 under a local anesthesia we carried out the grafting of 1200 cm² of skin from three donors. At first the transplants adhered, and after 8 weeks they had completely resolved. The wounds were reduced by almost 2 times. 5/13 and 8/19 under a local anesthesia a skin graft was made with the derma of 300-400 cm². He was discharged 8/19 in a satisfactory condition with minor granulating scars on the hips.

Case 2. Female patient, 23 years of age, on 8/18/59 in a kerosine stove explosion received extensive burns on the torso, upper and lower extremities. She was treated in one of the "oblast" hospitals. On the torso and upper extremities, the burns healed, on the lower posterior surface of the left lower extremity, extensive granulating scars formed with an area of nearly 800 cm². She entered a condition of marked emaciation.

The data from the electrocardiogram showed moderately expressed muscle changes. Other pathological changes of the internal organs were not disclosed in the investigation.

She was prepared for the operation with blood transfusions. Blood plasma albumen before the operation was 6.34%, hemoglobin, 58%, 9.6 mg%.

10/15, the operation. Forty minutes prior to anesthesia she was given 25 mg of Aminazin, 20 mg of Panthopon, 40 mg of Dimedrol and atropine. For 4 minutes under the constant supply of oxygen she was given intravenously 16 ml of a 2% solution of thiopental sodium. A deep sleep followed. After the injection of 10 ml of a 1% solution of Dithilin, she was intubated and controlled respiration was begun. At this moment

a significant cyanosis appeared, and then over a minute or two the pulse sharply worsened and disappeared. Heart beats could not be detected. The pupils dilated. Then through a cut in the fifth inter-costal space we opened the left pleural cavity and intersected the pericardium. The heart was not beating. Into the left ventricle we injected 2 ml of a 0.1% solution of adrenalin and began to massage the heart (in 2-3 minutes after its arrest). We lowered the head end of the table and compressed the celiac artery. Artificial respiration was continued throughout this time.

Three-four minutes after the inception of massage, weak heart beats appeared which faded when the massage was stopped. With intervals of 3-4 minutes we gave intracardially a solution of adrenalin in 1 ml doses. Massage was continued. Twelve minutes after the beginning of massage, the heart beats became regular, a pulse appeared in the peripheral vessels. The arterial pressure was 140/80 mm of mercury. Massage was ceased 4-5 minutes after the regular revival of the heart activity. Over 25 minutes we gave intra-arterially 500 ml of oxygenated blood after which we continued drop intravenous transfusion. During this time the contractions of the heart were rhythmical, regular, arterial pressure remained constant, and the pupils contracted somewhat.

One hour after the cardiac arrest, independent respiratory movements appeared. Independent deep and rhythmical respiration returned after 15 minutes. Intravenously we gave 10 ml of a 10% solution of calcium chloride and 40 ml of a 0.25% solution of novocaine. The incision in the chest wall was sewn up.

In 1 1/2 hours after the cardiac arrest there appeared the corneal reflex, and 15 minutes after this the reaction to the intratracheal tube. Extubation was carried out, and oxygen was given through the mask of the anesthesia machine. Arterial pressure 120/70 mm of mercury, pulse, 140-180 beats per minute, rhythmical. Respiration deep, rhythmical. The pupils continued to contract, and the reaction to light appeared. In view of the small motor stimulation we gave subcutaneously 1 ml of a 2% solution of Promedol. Then the pulse and arterial pressure remained stable. Periodically we noticed motor stimulation which disappeared after the injection of anesthetics.

Toward evening (9 hours after the thoracotomy) the patient began to orient herself in the surroundings, although consciousness remained somewhat impeded. On the following day there were no signs of cortical disturbances, and only a moderate increase in the tendon reflexes.

In the following days, the patient's condition improved slowly. The post-operative period was complicated by suppuration of the incision in the chest wound. 9/23 under a local anesthesia we carried out a free grafting of 400 cm² of skin with the derma. The operation went off well, and the post-operative period passed without complications. She was released in a satisfactory condition with healed wounds 2/3/60.

During the post-operative period in both patients over a long period of time (more than a month) we noticed a marked change of the electrocardiogram; sinus tachycardia, a disturbance of the atrio-ventricular conductivity, diffuse changes in the myocardium of the ventricles.

In the second patient for a week we were able to hear the noise of the rubbing of the pericardium. Evidently these disturbances were caused by hemorrhages brought on by the massage under the epicardium and between the muscle fibers, and also by the inflammation reaction of the pericardium as has been established by G. Paddie, O. Creech, B. Helpert (1956).

In the analysis of the reasons for cardiac arrest in the patients which we have observed and also in a number of other cases which have been described in literature, two circumstances attract one's attention:

- 1) the indisputable connection of cardiac arrest with the administration of anesthesia and intubation;
- 2) the period which has passed from the moment of the trauma and the presence of clinically noted emaciation.

Both the doses of thiopenthal sodium which were used for administering anesthesia and the speed of injecting it were usual. However here one must take into consideration a certain depression of the respiratory center which comes under the action of the barbiturates as well as their hypotensive action and stimulation of the parasympathetic nervous system (I. S. Zhorov, 1938). The development of hypotonia during the period of emaciation caused by the burning is caused also by the disruption of the vascular reflexes which occurs during this period; this has been established experimentally by the co-worker in the Burn Laboratory of the Clinic of Hospital Surgery, V. I. Skorik. The hypotonia leads to the development of hypoxia which a patient suffering from burns stands poorly (H. Middleton, F. Kunz, 1956).

During intubation there is an additional exacerbation of the exciter nerve and a possible reflector cardiac arrest which as has been proven in experimental research (H. Sloan, 1950) is only observed in the background of developing hypoxia.

The rapid disappearance of the pulse, the flabbiness of the heart muscle and also the good effect which is obtained after the intra-cardiac injection of adrenalin and direct massage are typical for vagus cardiac arrest (Ye. V. Gubler, 1957). Such was the clinical picture in the patients which we have described. All of this makes it possible to make a conclusion on the reflector (vagus) nature of cardiac arrest.

Unfortunately at present we cannot recognize the signs which enable us to predict this serious complication. One may only propose that the prophylactics against it involve an obligatory injection of atropine before anesthesia, a very slow injection of the thiopenthal sodium solution in a minor concentration (0.5%), with the constant administration of oxygen and a gentle technique in intubation. It is also expedient to have an additional local anesthesia of the trachea's mucous membrane. It is essential to have during the administration of the anesthesia the constant observation of the pulse, respiration and color changes in the skin covering, so that in the instance of cardiac arrest, immediate measures can be taken for revivification.

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(Address of N. Ya. Matusevich: Leningrad, Khalturin St, No 21, apt 2)